

Darwin's earthworms (Annelida, Oligochaeta, Megadrilacea) with review of cosmopolitan *Metaphire peguana*–species group from Philippines

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Abstract. A chance visit to Darwin allowed inspection of and addition to Northern Territory (NT) Museum's earthworm collection. Native *Diploreta zicsii* sp. nov. from Alligator River, Kakadu NP is described. Town samples were dominated by cosmopolitan exotic *Metaphire bahli* (Gates, 1945) herein keyed and compared morpho-molecularly with *M. peguana* (Rosa, 1890) requiring revision of allied species including Filipino *Pheretima philippina* (Rosa, 1891), *P. p. lipa* and *P. p. victorias* sub-spp. nov. A new *P. philippina*-group now replaces the *dubia*-group of Sims & Easton, 1972 and *Amyntas carinensis* (Rosa, 1890) further replaces their *sieboldi*-group. Lumbricid *Eisenia fetida* (Savigny, 1826) and Glossoscolecid *Pontoscolex corethrurus* (Müller, 1857) are confirmed introductions to the NT. mtDNA barcodes newly include *Metaphire houletti* (Perrier, 1872) and *Polypheretima elongata* (Perrier, 1872) spp.-complexes from the Philippines. *Pithemera philippinensis* James & Hong, 2004 and *Pi. glandis* Hong & James, 2011 are new synonyms of *Pi. bicincta* (Perrier, 1875) that is common in Luzon. Vietnamese homonym *Pheretima thaili* Nguyen, 2011 (non *P. thaili* Hong & James, 2011) is replaced with *Pheretima baii* nom. nov. Two new Filipino taxa are also described: *Pleionogaster adya* sp. nov. from southern Luzon and *Pl. miagao* sp. nov. from western Visayas.

Keywords. Soil fauna, invertebrate biodiversity, new endemic taxa, mtDNA barcodes, Australia, EU.

INTRODUCTION

Biodiversity assessment is important to gauge natural resources and determine regional changes. Earthworms are a crucial component of terrestrial fauna, vital for soil health and primary productivity (Darwin 1881), but their biodiversity in Australia's Northern Territory is poorly known and no comprehensive inventory yet exists. Rapid preliminary assessment is possible from inspection of museum collections and survey of botanic gardens. Both being concentrated repositories for endemic natives and introduced exotics which require considerable taxonomic expertise in order to identify correctly. The current study attempted a pilot earthworm eco-taxonomic biodiversity assessment during the author's brief visit to Darwin, the Territory's capital city, in March, 2015.

Although tropical Northern Territory occupies a vast area (1,420,970 km²) and an early descrip-

tion was of native *Diploreta eremia* (Spencer, 1896) from Alice Springs, only a dozen natives and just 8 exotics reviewed 33 years ago by Easton (1982) then Blakemore (1994, 1999, 2002, 2012a), give a present total of *ca.* 20 earthworm species – about the same number as found on a single farm in the south (see Dyne 1987, Dyne & Jamieson 2004, Blakemore 1994, 2008c).

The current report stems from a chance stop-over in Darwin allowing inspection of NT Museum's entire earthworm collection as well as a day (13th March, 2015) assessing the biodiversity of the Botanic Gardens. An earlier brief search (12th March, 2015) of likely shoreline hotspots on Mindil Beach, Fannie Bay failed to find *Pontodrilus litoralis* (Grube, 1855) that is known from the adjacent Harbour (Hanley 1997). Enquiries suggest quarantine excludes vermicomposting *Eudrilus eugeniae* (Kinberg, 1867) (see Blakemore 2015), whereas cosmopolitan exotic *Metaphire bahli* (Gates, 1945) was confirmed as common and

perhaps dominant elsewhere in and around Darwin township.

Resolving simple placement of *Metaphire bahli* has required extensive revision as its separation from prior *M. peguana* (Rosa, 1890) had been contentious until molecular methods apparently allowed differentiation (e.g. Nguyen *et al.* 2012: tab. 1 and Nguyen 2013: 123, fig. 3.39 showing 10.7% genetic separation in Vietnam; cf. its misidentification by Loongyai *et al.* 2011 in Thailand). Relationship to *Pheretima bangoiana* Michaelsen, 1934 and *P. saigonensis* Omodeo, 1956 remained unresolved as both were listed as synonyms (priority!) of *P. bahli* by Thai (2000) and Nguyen (2013: 46). Superficially similar Filipino taxon *Pheretima philippina* (Rosa, 1891) is reviewed.

The Darwin material directly links to the author's recent Philippine studies since several exotics were found in common and some natives are seemingly also new species. However, comparison of exotics and/or natives from the Philippines is inordinately difficult it being the only country in Asia without a complete checklist of earthworm species and to further lack specific DNA data (see Blakemore 2008a: map). Plus morphological synonymy is rife and earthworm species misidentifications by non-specialists are common in Philippines as elsewhere, which may also partly account for anomalous "interspecific comparisons" of their DNA concluded by Kvist (2014). For example, Blakemore (2010) found *Pheretima* (*Pheretima*) *urceolata* (Horst, 1893: 322) to include: *Pheretima baweanensis* Michaelsen, 1924; ?*P. ditheca* Michaelsen, 1928; James', 2004 *P. baletai*, *P. bukidnonensis*, *P. heaneyi* & *P. kitangladensis*; *P. simsi* James & Hong, 2004; Hong & James', 2008 *P. abiadai* and *P. nagaensis*; plus *P. batoensis*, *P. bicolensis*, *P. buhiensis*, *P. camarinensis*, *P. doriae*, *P. gorasi* and *P. viracensis* all by Hong & James, 2009.

DNA extraction was attempted for all new material in this report. For earthworms, initial molecular treatment was by Siddall *et al.* (2001) with first explicit typification by Blakemore *et al.* (2010) using the mtDNA COI barcode standard with 3% threshold (Hebert *et al.* 2003).

MATERIALS AND METHODS

Taxonomic identifications follow keys and classifications in Sims & Easton (1972) updated by Blakemore (2000, 2008a, 2012a). New specimens in 80% EtOH are lodged in the NT Museum and provided small tissue samples for mtDNA COI barcoding with preliminary analysis via NCBI-BLAST (Altshul *et al.* 1990) compared using MEGA6 (Tamura *et al.* 2013). The evolutionary history was inferred by using the Maximum Likelihood method based on the Tamura-Nei model (Tamura & Nei 1993). The tree with the highest log likelihood is shown. Initial tree(s) for the heuristic search were obtained automatically by applying Neighbor-Join and BioNJ algorithms to a matrix of pairwise distances estimated using the Maximum Composite Likelihood (MCL) approach, and then selecting the topology with superior log likelihood value. The tree is drawn to scale, with branch lengths measured in the number of substitutions per site (next to the branches). The analysis involved 33 nucleotide sequences. Codon positions included were 1st+2nd+3rd+Noncoding. All positions containing gaps and missing data were eliminated. There were a total of 527 positions in the final dataset.

Philippine material originally in 70% EtOH now in 100% Glycol intended for deposition in the National Museum, Manila is held under Fisheries Department license at UPV, Miagao Museum, care of School of Technology Dean, Dr. Emeliza C. Lozada. All PI collecting was overseen by UPV staff using my APN funds. Discussion and Conclusions are confined to Remarks after species' descriptions. Genbank accessions for Fig. 1 are in Table 1.

Abbreviations used: ANIC – CSIRO's Australian National 'Insect' Collection; APN – Asia Pacific Network; C – circumference of body; EU – European Union; Fp, Mp, Np, Sp – female, male, nephro-, & spermathecal pores; GMs – genital markings; lhs, rhs – left, right hand sides; NT – Northern Territory; PI – Philippine Islands; UPV – Uni. Philippines, Visayas; PNG – Papua New Guinea; syn. – synonym; US – U.S.A.

Table 1. Genbank Accession Numbers for Figure 1.
(batch BankIt1852350)

Code	Acc. No.	Code	Acc. No.
P0	KT626574	P15	KT626587
K1a	KT626575	Pe1	KT626588
K1b	KT626576	Pe2	KT626589
K2	KT626577	Pe3	KT626590
P1	KT626578	Pe4	KT626591
P4	KT626579	Pe7	KT626592
P5	KT626580	Pe8	KT626593
P7	KT626581	Pe9	KT626594
P9	KT626582	M1	KT626595
P10	KT626583	D3	KT626596
P11	KT626584	D4	KT626597
P12	KT626585	D5	KT626598
P14	KT626586		

TAXONOMIC RESULTS

Family classification of megadrile Oligochaeta Grube, 1850 s. lato (= Clitellata but see Timm 2012) as used herein follows Blakemore (2000, 2013a) rather than Gates (1972).

Entire earthworm samples in NT Museum collection identified by the author

- D992: "EAST PT (Block) A/11 5/5/75 Coll. R. Pengelley." Two medium-sized *Metaphire bahli* (Gates, 1945).
D994: "EP RF B1 11/5/75"; "E. Pt Darwin E.P." An *M. bahli* mature.
D995-D1020 (excluding D1003, 1009 and 1012), D1025-D1028 and D1041 were all *Metaphire bahli* from East Point, Darwin with collection details similar to D992.
D1021: "Moulden Palmerston NT Coll. M. Neal 25 March, 1999"; "ex soil in Moulden Staghorn Crt garden." Ca. 15 specimens, all poorly preserved, identified as *M. bahli*; *Diploptrema* sp1 and *Diploptrema* sp2.
D1022: Same details as D1021, *M. bahli* and *Diploptrema* sp. (too poor to describe).
D1023: "Virginia nr Darwin Coll. S. Gregg Nov 20, 1995". An immature megadrile.
D1038: "EAST POINT, DARWIN N.T. 12°25'S 130°49'E Coll. R. Pengelley 17 Jan 1976"; "CSIRO PT BLOCK A 17/1/76 EW." Three *Diploptrema* sp. (poor preservation).
D1039: "N.T. Darwin 20.xii.1992 M.B. Malipartu."; "Berlesate ex log." 18 specimens ?*Amyntas* sp. (poor preservation).
D1419: Described below as *Diploptrema zicsii* sp. n.; DNA samples D-1–2.
D1427: "W247"; "Commercial worm farm 33 Dalwood Rd, Karama NT 12°23.304'S 130°54.307'E Coll: R.W. Swan 17/03/2010". Two lumbricid *Eisenia fetida*.

D1530: Two *M. bahli* from Darwin Botanic Gardens, larger one providing DNA (D-3); coll. RJB 13th March, 2015.

D1528: One *Pontoscolex corethrurus* from Darwin Botanic Gardens DNA (D-4); coll. RJB 13th March, 2015 (other specimens not kept).

D1529: One *M. bahli* from the NT Museum grounds near the laboratory DNA (D-5); coll. RJB 13th March, 2015.

In addition, an exotic "*Dichogaster* sp." (Octochaetidae, Benhamiinae) was identified in a sample (Blakemore 1995: ANIC RB.95.27.2) provided in January, 1994 by Randal Hinz from a 20-year-old rehabilitated mine site in lateritic soils at Gove Peninsula, Northern Territory, characterized in Blakemore (2002, 2012a) thus: *One pair of spermathecal pores in ab lines in 8/9. Two oesophageal gizzards in 7 & 8, three pairs of calciferous gland in 15-17, prostates paired in 17 only with long penial setae. Spermathecal duct tapering from spheroid ampulla with small diverticulum mid-length, nephridia in approximately 10 rows per side.*

Other specimens from this Gove site were cosmopolitan *Dichogaster saliens* (Beddard, 1893) as a new exotic record for NT plus a new native *Diploptrema* sp. (ANIC: RB.95.27.1) that I had at the time hoped to shortly publish contingent upon funding.

Description of new and known Northern Territorian/PI taxa

ACANTHODRILIDAE Claus, 1880 *sensu* Blakemore 2000, 2013a

Diploptrema Spencer, 1900

Eodrilus Michaelsen, 1907

Diploptrema zicsii sp. nov.

(Figure 2)

Material examined. Labelled: "Naididae (Oligochaeta) S. Alligator River Kakadu NP NT 13°31.465'S 132°31.899'E. Coll. R.C. Willan & party 10/07/2004." In red pen on lid: "100% Ethanol". Two specimens, a mature – D1419, the Holotype – plus D1531 an immature Paratype ex D1419; providing tissue samples D-1 & D-2 that due to aging unfortunately failed to yield DNA (Prof. Chris Austin pers. comm.).

Description. Yellowy in alcohol. Size, 25 x 1.7 mm with 105 segments. Prostomium prolobous. First dorsal pore small in 8/9. Closely paired lumbricine setae; genital setae in 9 displaced anteriorly above ventral pads; penial setae in 17 & 19; setae *ab* not found on 18. Clitellum annular 13–16 or thereabouts. GMs paired tumid pads in 9 plus

elongate patch in 16/17 and two pairs of sucker-like discs in 17/18 & 18/19 between prostatic pores and seminal grooves from 17–19. Spermathecal pores near setal *a* lines in 7/8 & 8/9. Female pores paired above setae *a* on 14. Acanthodriline male pores not located (likely in position of missing *ab* setae?).



Figure 1. Phylotree from MEGA6 with specimen details in text and from Blakemore (2015) and Blakemore *et al.* (2014); black squares are for Darwin, triangles for Vietnam and a circle for the Japanese Lake Biwa outgroup taxon.

Septa 4/5/6 thin, 6/7 a bit thicker, others again thin. Pharyngeal mass in 4. Gizzard muscular in 5. Spermathecae in 8 & 9 as spherical ampulla on thin duct with multi-loculate, sessile diverticulum occupying duct mid-length. Genital setae overlain by spermathecae in 9. Dorsal blood vessel single; last hearts in 13. Holandric: testes free and iridescent in 10 & 11; seminal vesicles in 9–12 the latter largest. Ovaries with large egg cluster in 13; ovisacs or pseudovesicles in 14. Intestinal origin in 16; no calciferous glands. Prostates with penial setae in 17 & 19. No tumidity noted ventrally in region of spermathecae nor male pores. Nephridia vesiculate, holoic. Gut contains colloidal material.

Immature Paratype appears to have segments 1–2 fused; moreover it lacks the GM pads in 9 but has faint markings in 16/17 and pairs in 17/18 & 18/19. Penial setae are present in 17 & 19 and no *ab* were found on 18 in position of male pores.

Etymology. Named in tribute to Prof. Dr. András Zicsi the Hungarian oligochaete systematist of renown.

Remarks. Having seminal vesicles in 9–12, the current mature specimen most closely resembles Spencer's *D. eremia* which is itself similar to *D. shandi* Jamieson & Dyne, 1976 from Bing Bong Road, NT. *D. eremia* differs however in many points, such as having several ventral GMs in some of 19/20–29/30 and twin diverticula to its spermathecae. The spermatheca of *D. shandi* are more similar to *D. zicsii* and it has a GM pad in 16/17 too; however, it has extra markings in 19/20–21/22 and entirely lacks both the distinctive pads with genital setae in 9 and the paired GMs in 17/18 & 18/19. Its prostates extend through segments to 24 or 25 unlike in the current species where they are mostly confined to 17–19, although this character is probably of lesser import.

MEGASCOLECIDAE Rosa, 1891 s. stricto

Amyntas Kinberg, 1867, *Metaphire* Sims & Easton, 1972, *Pheretima* Kinberg, 1867 s. stricto and *Polypheretima* Michaelsen, 1934 (see Blakemore, 2008b)

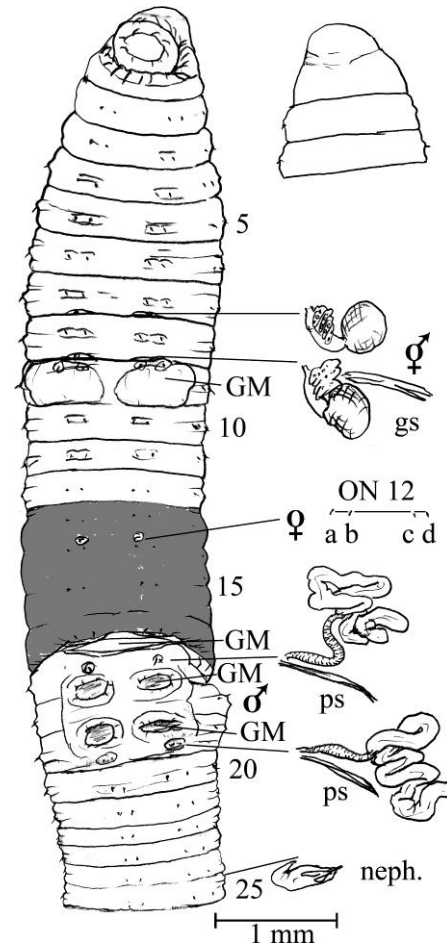


Figure 2. *Diplotrema zicsii* sp. nov. Holotype. gs = genital setae, ps = penial setae.

Metaphire bahli and allied spp reviewed chronologically after a key to the species

Note. Taxonomic differentiation between *Pheretima* and *Metaphire* is mainly on the presence of nephridia on the spermathecal ducts in the former (also sometimes found in *Amyntas* that, however, has superficial male pores and is the prior “default” pheretimoid genus) (Sims and Easton 1972). The function of spermathecal nephridia has not been adequately explained; perhaps they communicate with the lumen as with the enteronephric, septal nephridia first noted by Bahl (1919) for some pheretimoids or, more likely, they are exonephric, integumentary nephridia incidentally collected by developing spermathecae as they improve through the body wall.

**Key to pheretimoids with spermathecal pores
6/7/8/9 and GMs paired within 17-19**

1. Male pore superficial 2
Male pore non-superficial 6
2. GMs in 17/18 & 18/19 median to line of male pores 3
GM in 17/18 & 18/19 more widely paired and other GMs may be present 4
3. Green with fetid smell, coils in soil, spermathecal diverticula longer than ampullae
..... *Amyntas hupeiensis* (Michaelsen, 1895)
Asian cosmopolitan, common in paddy – see Blakemore (2012a) for full description.
Pale colour, very active in soil, spermathecae variable in number with diverticula short or absent
..... *Amyntas micronarius* (Goto & Hatai, 1898)
from Japan & Korea (including Jeju) – see Blakemore (2012b) for full description.
4. GMs in 17–19 also *A. minahassa* (Michaelsen, 1896)
from North Celebes.
GMs other than 17/18 & 18/19 lacking 5
5. Male pore on discoidal porophore
..... *Amyntas fucosus* (Gates, 1933)
from Myanmar.
Male pore simple.... *Amyntas enkyokuan* (Ohfuchi, 1951)
from Sansei, China.
6. Intestinal caeca simple from 27 7
Intestinal caeca manicate in 27 or simple in 22 12
7. GMs paired within 18 or overtly near (one or more may be missing) 8
GMs in 17/18 & 18/19 invaginate
..... *Metaphire bahli* (Gates, 1945).
8. Nephridia absent from spermathecal ducts 9
Nephridia on spermathecal ducts
..... *Pheretima philippina* (Rosa, 1891)
sub-spp from PI; GMs actually within copulatory pouch, sometimes everted on preservation.*
9. Male & spermathecal pores ca. 0.3 or more circumference apart 10
Male & spermathecal pores much closer
..... *M. saigonensis* (Omodeo, 1956).
10. GMs sucker-like in 17/18 & 18/19
..... *Metaphire peguana* (Rosa, 1890).
GMs not so 11
11. GMs small inside Sp pores and/or male pores
..... *Metaphire houlleti* (Perrier, 1872).
Small GM discs equatorial 17 & 19
..... *Metaphire posthuma* (Vaillant, 1868)
cosmopolitan, typically four pairs of spermathecae in 5/6/7/8/9 but anterior pair may be aborted as in some of its *Perichaeta affinis* Perrier, 1872 synonym, or further reduced.
12. Caeca manicate
..... *Metaphire pacseana* (Thai & Samphon, 1988)
ex Vietnam/Laos.
Intestinal caeca simple in 22 *Pithemera eldoni* (Gates, 1975) from PNG.

*Several other Philippine pheretimoids have markings in 17/18 & 18/19 such as *Pheretima albobrunnea* and *P. incerta* – both poorly described by Beddard (1912) – and *Pleionogaster adya* sp. nov. (as described below) but these have spermathecae in 4/5/6/7/8/9, 5/6/7/8/9, and 7/8/9 respectively. Two other sexthecal/octothecal species: *P. decipiens* Beddard, 1912: 180 and *P. benguetensis* Beddard, 1912: 183 lack GMs, but data provided herein suggest these require review and possible restoration [cf. *P. vaillanti* (Beddard, 1890) currently in *P. darnleiensis* (Fletcher, 1886) that Gates (1937: 320) also recorded from “Batoran, Luzon” (= Bataan?) as “*Pheretima indica*”]. Sivickis (1930) studied what he identified as *P. benguetensis* from UP, Manila and from Pasig township; it is also claimed from Quezon City, Luzon. However, *P. decipiens* is the page prior species should they eventually be united, which at present I avoid doing.

It is here derived that *P. decipiens* which occasionally has spermathecae in 6/7/8/9, typically has four spermathecal pairs in 5/6/7/8/9 since Beddard (1912) compared it to members of the *P. darnleiensis*-group with four pairs in 5/6/7/8/9 and stated: *the number of spermathecae (although I found only 3 pairs in one individual) serves to differentiate P. decipiens* [also four pairs in 5/6/7/8/9] *from P. philippina* [three pairs in 6/7/8/9] and *P. pura* [two pairs in 6/7/8].

Sims & Easton (1972: 239) put *P. decipiens* in a *Metaphire planata*-group with spermathecae in 6/7/8, this in error I believe for two reasons: Firstly, they defaulted to *Metaphire* rather than to prior *Pheretima* if state of nephridia on spermathecae was unknown (as stated by Sims & Easton 1972: 231); secondly, spermathecae are interpreted as being in 5/6/7/8/9 in typical *decipiens* from Beddard's rambling account as just noted above, thus it more properly belongs in their *Pheretima darnleiensis*-group.

Blakemore *et al.* (2007a: 29) newly put *decipiens* in synonymy of *P. darnleiensis* – supported at least in one of Beddard's (1912: 182) specimens having “a small accessory diverticulum”

thought characteristic of *darnleiensis*. This move at that time was mainly because Sims & Easton (1972: 261) had included *P. benguetensis* Beddard, 1912 under *P. darnleiensis* and because Beddard (1912: 181, 183) had repeatedly said his *decipiens* and *benguetensis* are almost identical. Both *decipiens* and *benguetensis* have enlarged setae with reduced numbers in segments 2–9 [not just in 2–8 as claimed by Hong & James (2010: 530)] which supposedly separated them from *P. darnleiensis* and its ilk according to Beddard (1912: 181) although Sims & Easton's (1972: 262) redescription allowed this in *P. darnleiensis* too (cf. *P. poiana* Michaelsen, 1913 with spermathecae in 6/7/8/9 as with the sexthecal form of *P. decipiens*).

Pheretima decipiens was differentiated from *P. benguetensis* by Beddard (1912: 182) only by smaller size (i.e., somewhat shorter than 150–190 mm) and by its spermathecal diverticulum being not so long as the spermatheca itself (longer in *benguetensis*); perhaps also intestinal origin in 16 or 17 (but actually 16?), respectively. These characteristics also apply to sympatric *P. cabigati* Hong & James, 2008; Hong & James', 2010 *P. pugnatoris* and *P. tabukensis*; Hong & James' 2011a *P. margaritata*, *P. kalbaryoensis*, and *P. thaii*; and *P. barligensis* Hong & James, 2011b – all potential junior synonyms of *P. darnleiensis* and/or *P. decipiens* and needing yet more work.

Note. Taxonomic 'housekeeping' requires Vietnamese *Pheretima thaii* Nguyen, 2011 (published in March, 2011, Dr Nguyen Duc Thanh pers. comm., non prior *P. thaii* Hong & James, 2011 from Philippines published 28th Feb., 2011), a primary homonym named after Dr. Thai Tran Bai, be given a replacement name, here as *Pheretima bairi* **nom. nov.** with author Dr Nguyen Thanh Tung's permission (Dr Nguyen Duc Ahn pers. comm. 13th April, 2015). This species and its companion are then both transferred to *Metaphire* as *M. bairi* (Blakemore, 2016) and *M. mangophila* (Nguyen, 2011) **combs. novae**.

Pheretima decipiens Beddard, 1912: 180 is herein compared in part (its sexthecal form) to

new *P. philippina* sub-spp. described below. Simultaneously, *Pheretima incerta* Beddard, 1912: 197 is again transferred as a likely synonym of *Metaphire posthuma* in the description immediately following.

Metaphire posthuma (Vaillant, 1868)

(Figures 3A–D, 10)

Perichaeta posthuma Vaillant, 1868: 228, (non figs. 1–8); 1869: figs. 9–11. [Type locality Java. Types in Paris Museum, possibly AE656–668].

Perichaeta affinis Perrier, 1872: 106, fig. 66; 1875: 1044. [Type localities Saigon and Luzon, P.I. Type in Paris AE669].

Amyntas posthumus: Michaelsen 1899: 74.

?*Amyntas quadripapillatus* Michaelsen, 1899: 93, fig. 17 (of a spermatheca). [From Sumatra, Bindjey Estate. Types in Hamburg missing?]. **Syn. nov.?**

Pheretima posthuma: Michaelsen 1900: 295 (syn. *affinis*); Gates 1972: 212; Nguyen 2013: 56, figs. 2.5, 3.11 (syn. *incerta*, *rhabdoida* Chen, 1938).

?*Pheretima incerta* Beddard, 1912: 197. [From Manila, Luzon, P.I. Types?].

[*Pheretima rhabdoida* Chen, 1938. From Hainan. Types? This is unlikely synonym as the taxon, supposedly having superficial male pores, is now held in *Amyntas*].

Metaphire posthuma: Sims & Easton 1972: 239 (*posthuma*-group); Blakemore 2002, 2008b (syn. *affinis*, *incerta*), 2012a (syn. *affinis*).

Notes. Few reliable characters separate octothecal *P. incerta* from octothecal forms of *M. posthuma*, apart, perhaps, last hearts supposedly in segment 12. Sims & Easton (1972: 237, 243) misspell subspecies name *Amyntas kanrazanus incertus* (Kobayashi, 1937) as "*incertus*" and say "(non Beddard, 1912)" confusing it with *P. incerta*, thus no replacement name is required, as already noted by Blakemore (2013b: 28). *Metaphire quadripapillata* (Michaelsen, 1899: 93) is similar, if not newly synonymous, too.

Charles Darwin (1881: 106) (mistakenly?) attributed to it large tower-like casts found at Nice in southern France (Fig. 3D) and it was also recorded from Kew Gardens, London by Beddard (1906) – both were new European records. Full description and distribution is provided by Gates (1972) and Blakemore (2002, 2012a).

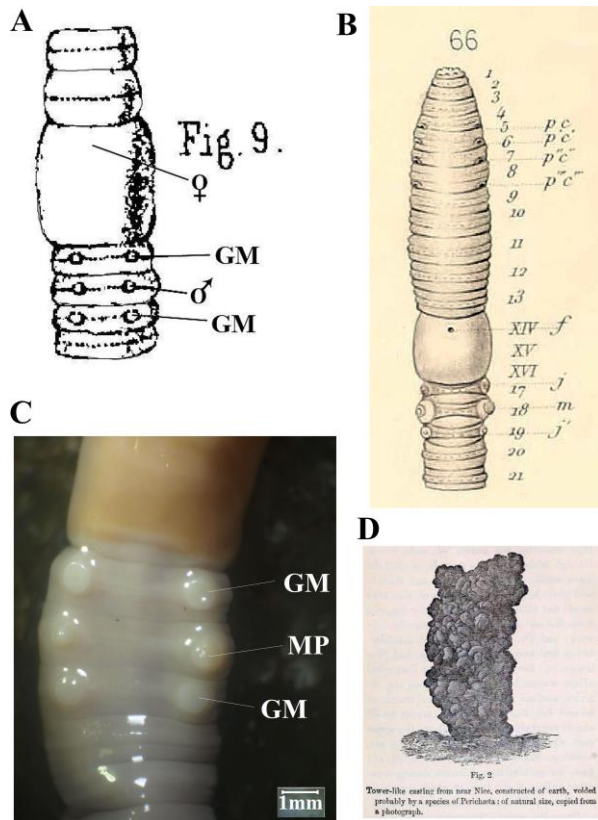


Figure 3. *Metaphire posthuma* (Vaillant, 1868): A = From Vaillant (1869: fig. 9); B = Synonym *Perichaeta affinis* Perrier, 1872: fig. 66; C = Male field photo (RJB Feb., 2014) of specimen newly record from Mindanao, PI; D = Casts from Darwin (1881: fig. 2).

Metaphire houlleti (Perrier, 1872)

(Figures 1, 3D, 4, 10)

Metaphire houlleti is part of a species-complex s. Blakemore (2012a) (*Pheretima houlleti* s. Gates 1972) thought to comprise parthenogenetic morphs distinguishable by somatic and genital characters with number of spermathecae ranging from three pairs in 6/7/8/9 to fewer in various athecal morphs (Gates 1972). Synonyms number around fifteen names, most recently including Taiwanese *Amyntas huangi* James *et al.* 2005. A cosmopolitan complex (Fig. 10) here barcoded apparently for the first time (Figs. 1 & 4) with BLAST of JET-147 vs. Pe9 Identities = 511/632

(81%), i.e., different taxa, confirming a molecular species-group requiring review with possible restoration of some earlier synonyms; Blakemore (2011, 2012a) provides full details. It is currently spp-group representative of more than 42 named taxa, cf. *M. peguana* spp-group of originally just three (*bahli*, *peguana*, and *saigonensis*) from Sims & Easton (1972: 239).

Perichaeta houlleti (= *M. houlleti*) was also assumed by Darwin (1881: 106) partly responsible along with *Pe. affinis* (= *M. posthuma*) and *Perichaeta luzonica* Perrier, 1875 – a junior synonym of *Lampito mauritii* Kinberg, 1867 (and partly of *Polypheretima elongata*?) – for casts found at Nice, France (Fig. 3D). All three exotics were introduced to the EU in historical/imperial times but their current status is unknown.

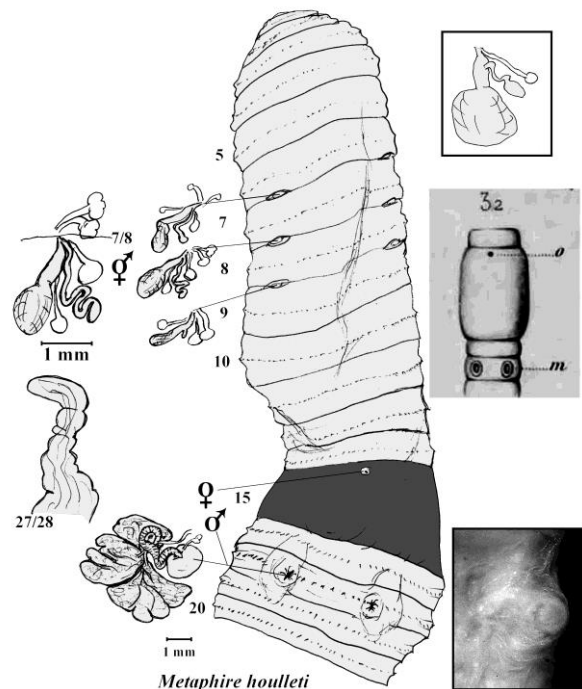


Figure 4. *Metaphire houlleti* species-complex: Thai specimen (Tokyo NMST An 425, DNA JET-147) compared to Perrier's original fig. 32; boxed are a spermatheca sketch and rhs male field photo of Filipino Hacienda Remedios organic canefield specimen (DNA Pe9). Note: DNA samples differed 19% suggesting different taxa.

***Metaphire peguana* (Rosa, 1890)**

(Figures 1, 5A–D, 10)

Perichaeta peguana Rosa, 1890: 113, figs. 6–8 (pg. 1057). [Type locality Rangoon. Types in Genoa, 44037 and, from Gates (1925: 327), in British Museum and US Museum Cat. No. 46]; Rosa 1898: 289 [augmented original account on Thailand material in London from “*Chantaboon, Siam*” (inspected by Beddard 1900?)].

Amyntas (Pheretima) peguanus: Michaelsen 1899: 7 (noting similarity to *A. hupeiensis*).

Amyntas peguanus: Beddard 1900: 628.

Pheretima peguana: Michaelsen 1900: 292, 1922: 44 (in part?); Stephenson 1923: 308, 1932: 49, fig. 5 (of spermatheca); Gates 1925: 561, 1972: 207 [syn. *saigonensis*; (non Ohfuchi 1957: 171 from Okinawa that is actually an *Amyntas* sp.)].

Pheretima (Pheretima) peguana: Omodeo 1956: 325, figs. 1, 3, 5. [?Non Michaelsen 1922: 44 (cf. *M. saigonensis*)].

?[*Pheretima saigonensis* Omodeo, 1956: 327. Locality Saigon. Types in Verona, 15].

Metaphire peguana: Sims and Easton 1972: 239 (*peguana*-group); Blakemore 2002, 2003: 33, 2006, 2008, 2009: 265, 2010, 2012a. [Non Somniam & Suwanwaree (2009: 222) misidentification based on Somniam (2008: figs. A, 10D, F) of another species].

Diagnosis. Bright red dorsum. 140–240 mm with 98–121 segments and 56 setae on 8 (ventral setae are larger and more widely separated). Spermathecal pores paired *ca.* 0.3 circumference apart in 6/7/8/9. Male pores within copulatory pouches on segment 18. Genital markings paired rings with central apertures across 17/18 & 18/19. Spermathecal diverticula much coiled. Intestinal caeca simple, smooth edged from 27.

Distribution. Myanmar; Thailand; Vietnam; Cambodia (Thai & Do 1989); Penang, Malay peninsula; Singapore; Java (Tandjong Priok, Djakarta *cf. M. saigonensis*); Borneo (“*Lombok Bay, Labuan*”, *i.e.*, Kalimantan and East Malaysia); St Paul’s Cathedral Calcutta (Kolkata) and Indian Botanic Gardens at Howrah, but now (after Gates 1972: 209) excluding Japan (Okinawa). Possibly confused with *P. bahli* in the past.

Remarks. Gates (1972: 209) said that one or more of the genital markings in 17/18 & 18/19 are occasionally absent and preservation may cause eversion of male organs from copulatory pouches (*cf. P. philippina*). He included *saigonensis* in synonymy because the differences by which it was distinguished “*are quantitative, trivial, and of*

characters liable to more or less individual variation.” However, the description by Omodeo (1956: figs. 1, 3, 5 – here as Fig. 5C vs. 5D) shows its male and spermathecal pores much closer than in *M. peguana* proper. Moreover, Omodeo (1956: 325) thought Michaelsen’s (1922: 44) “*P. peguana*” from Java possibly refers to *M. saigonensis* which – if correct – would expanded its distribution to Indonesia. Until confirmation, I suggest confining a restored *M. saigonensis* to its type locality of Saigon (Ho Chi Minh City).

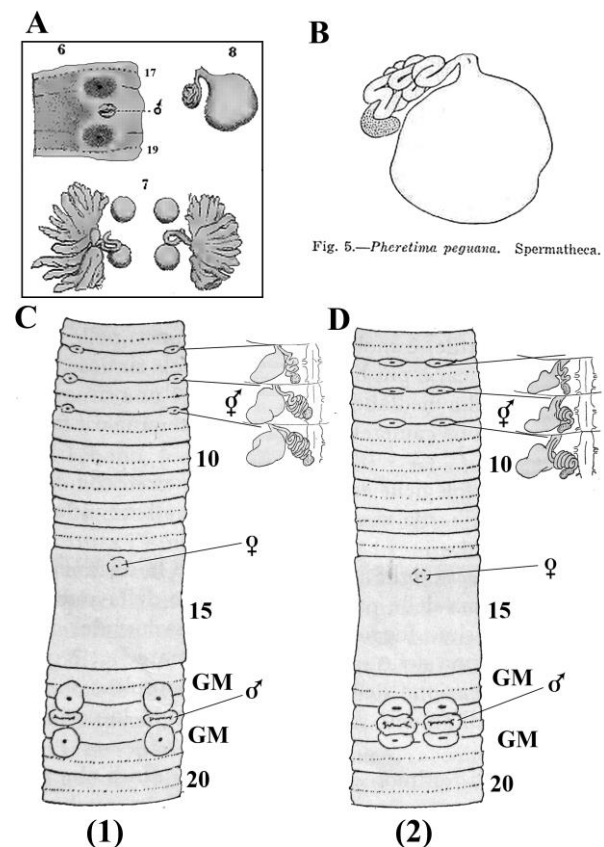


Figure 5. *Metaphire peguana* (Rosa, 1890). A = Rosa’s figs. 6–8; B = Stephenson’s (1932: fig. 5); C = *M. peguana* (1) *cf.* D = *M. saigonensis* (2) after Omodeo (1956: figs. 1–4).

***Pheretima (Pheretima) philippina philippina* (Rosa, 1891)**

(Figure 6)

Perichaeta philippina Rosa, 1891: 397, fig. 5 (of internal male organs only). [Type locality “*Insel Cebu*”. Types in Vienna].

?[*Amyntas bindjeyensis* Michaelsen, 1899: 94, fig. 18. Now retained in *Metaphire*].

Amyntas philippinus: Beddard 1900: 616 (syn. *bindjeyensis*).

Pheretima philippina: Michaelsen 1900: 294, 1913: 89 [comparing his new *P. poiana* with spermathecae in 6/7/8/9 to *Metaphire merabahensis* (Beddard & Fedarb, 1895) with spermathecae in 5/6/7/8, both from Sarawak; he was likely mistaken to say the latter was probably the same as *P. philippina*]; ?non Gates 1937: 327 (see *P. philippina victorias* ssp. nov. below).

Pheretima (Pheretima) philippina: Sims and Easton 1972: 239 (mistakenly in a *pura*-group with spermathecae in 6/7/8 rather than its proper *dubia*-group herein replaced with a *philippina*-group with spermathecae in 6/7/8/9).

Description. Dark slate-coloured, black/brown. Size 180–240 x 7 mm (cf. 200–300 mm current specimens). Segments 115–125. First dorsal pore 11/12. Perichaetine with 44 setae on 8; 70 setae on 12 (type). Clitellum annular 14–16. GMs absent. Spermathecal pores three pairs in 6/7/8/9 in setal lines five or six. Female pore central on 14. Male pores as wrinkled secondary pores in setal line seven or eight on 18.

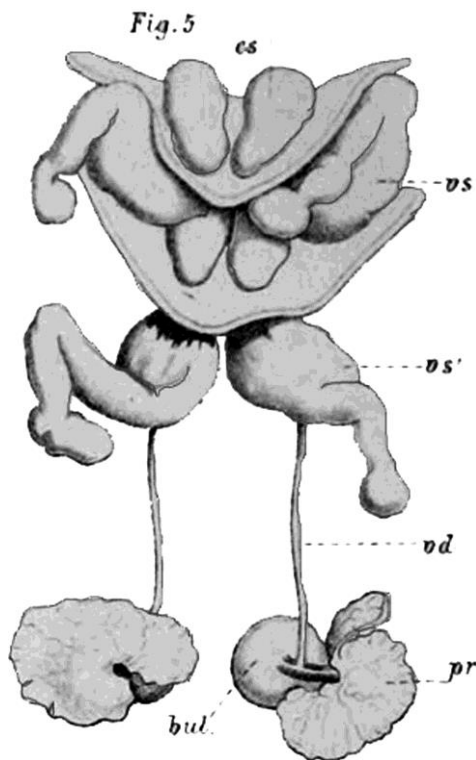


Figure 6. Male organs of sexhectal *Pheretima philippina* (Rosa, 1891: fig. 5) (surprisingly the only figure available for this classical, group representative species).

Septa 7/8 and 10/11/12/13 thick, 8/9/10 aborted. Crop in 7; gizzard in 8. Spermathecae in 7–9 as spherical or pear-shaped ampulla on thick duct (nephridia attached) having thin diverticulum with terminal bulb. Hearts in 10–13. Holandric: sacular testis in 10 & 11; seminal vesicles in 11 & 12 the latter pair with longer diverticula. Ovaries in 13; no ovisacs. Prostates smallish, kidney-shaped, racemose in 18 with short, unbent duct to muscular copulatory pouches. Nephridia meroic. Intestinal caeca extend for three segments from 26 (origin likely in 27).

Distribution. Cebu (type-locality); cf. Luzon and Negros Isls. (new sub-spp. below).

Remarks. Rosa said his species was similar to *P. vaillanti* (Beddard, 1890) from Manila that, however, has four pairs of spermathecae and is currently held under *P. darnleiensis*. Sumatran *P. bindjeyensis* was vouched for by Michaelsen (1913: 90) and put in *Metaphire* by Sims & Easton (1972) who listed all species regardless of synonymy.

***Pheretima philippina*-group takes priority from Sims & Easton's, 1972 *dubia*-group**

Pheretima philippina Rosa, 1891 rightly belongs in Sims & Easton's *dubia*-group that originally comprised four species with spermathecae in 6/7/8/9, viz.: *callosa* Gates, 1937: 313, *dubia* (Horst, 1893: 68) and *korinchiana* Cognetti, 1922: 2 both from Sumatra, plus *poiana* Michaelsen, 1913: 88 from Sarawak and Kalimantan. However, Cognetti (1922: 2, figs. 3A–B) described *P. korinchiana* with spermathecae in either 7/8/9 (*sluiteri*-group) or 6/7/8/9 (*philippina*-group); Cognetti's figures did not show nephridia on spermathecal ducts but placement in *Pheretima* is likely accepted following inspection of British Museum paratypes (1927:7.30.1–2) by Sims & Easton (1972: 180).

Gates (1937) described *P. callosa* on a specimen (330 mm long) from Benguet, northern Luzon, separating it from (his concept) of *P. philippina* on a few anatomical points (noted under description of *P. philippina lipa* ssp. nov. below).

Five “*dubia*-group” *Pheretima* from northern Luzon, PI were added by Hong & James (2010, 1011a, b), viz.: *P. balbalanensis* & *P. banaoi* from Kalinga Province; *P. globosa* from Ilocos Norte; and *P. lamaganensis* & *P. julkai* from Mountain Province – all of which are small and similar (synonyms?) that they nevertheless thought different to *P. philippina* (and *P. callosa*?). Having spermathecae impinging either before or after a septum is largely incidental and irrelevant taxonomically, e.g., these varied intra-specifically in *P. decipiens* Beddard (1912: 182) and *P. monticola* Beddard (1912: 197) and are often seen in other species (pers. obs.). Hong and James (2011b: 24) misinform that *P. philippina* type-locality is Mindoro.

Taxonomic note. *Pithemera glandis* Hong & James, 2011a is clearly a new synonym, along with *Pi. philippinensis* James & Hong, 2004, of prior *Pi. bicincta* (Perrier, 1875) from Luzon. Also their *Pheretima aguinaldoi* and/or *P. banaoi* and *Pithemera levii* are *incertae sedis* as Hong & James (2010: fig. 2 cf. figs. 3 & 4 and 2011b: fig. 7) have obviously miscounted segments.

DNA data (Fig. 1) is newly provided for *P. philippina* that, however, shows genetic differences of >8% indicating likely separate taxa. Since neither group is from the nominal type-locality (Cebu Island), and it is not certain that Gates was dealing with typical material from Negros Is. either, they are both here named at subsp. level pending fuller resolution. Descriptions of these two newly proposed *P. philippina*-group taxa follow.

***Pheretima philippina lipa* ssp. nov.**

(Figures 1, 7A–J)

?*Pheretima decipiens* Beddard, 1912: 180 part (specimen with “only 3 pairs” of spermathecae thus likely compliant with *philippina*-group). [From 1,524 m at Benguet, Luzon as for *benguetensis* from Beddard (1912: 183). Types missing].

Material examined. Holotype, UPV specimen code #S24 mature, 300 mm long, sketched and dissected providing DNA tissue sample (P12)

from beside wind-pump and water tank next to caribou wallow at Kahariam organic farm Lipa City (13°56'28"N 121°09'44"E), Batangas, PI; coll. 14th Nov., 2013 by RJB & Rowena Ocenar; Paratype-1 #S25 slightly smaller specimen (200 mm long) from same batch that agrees superficially (no DNA); Paratype-2 #S26: same batch, mature 200 mm long with everted male pores, providing DNA (code P13 that, due to avoidable UPV delay in sending, yielded no result); Paratype-3 #S14 acitellate mature, 200 mm long, dissected and providing DNA sample (K1a) from under stone beside farm office coll. RJB 14th Aug. 2013; Paratype-4 #S19 mature 245 mm long from rice paddy near shooting range (DNA P6 nil result) coll. 14th Nov. 2013. Specimen UPV #S13 mature (310 mm), dissected providing DNA (“K1b”) from greenhouse at Kahariam in vermicompost, 22nd Nov. 2013 by UPV staffers.

Diagnosis. Large worm with dark dorsum but paler intersegments and setal auriolae. Complying with nominal species except size range slightly larger (viz. ca. 200–300 mm by 5.5 mm), first 9 segments are darker with larger setae (as per *P. decipiens*), pro-epilobous prostomium, dorsal pores from 12/13, setae ca. 40–50, ca. four or six setae between male pores. Copulatory pouch contains two genital pads either side of the penis, which may be everted on preservation, as seen in Paratype-2. Septa 8/9/10 aborted. Peptonephridia in 4–6. Spermathecae in 7–9 as spherical ampulla on thick duct (with nephridia attached) having straight or slightly wavy diverticulum almost to tip of ampulla with terminal bulb. Seminal vesicles in 11 & 12 have appendages. Last hearts are in 12 (or 13 in #S13). Prostates on short duct. Intestine from 16; caeca thin and simple from 27; gut contains soil rather than litter.

Etymology. After type locality near Lipa City, Batangas.

Distribution. Southern Luzon (and more northerly for “*decipiens*” specimen?).

Remarks. The two prior sexthecal species from Philippines are *P. philippina* (Rosa, 1891) from Cebu (plus Gates' 1937: 327 claim from Negros

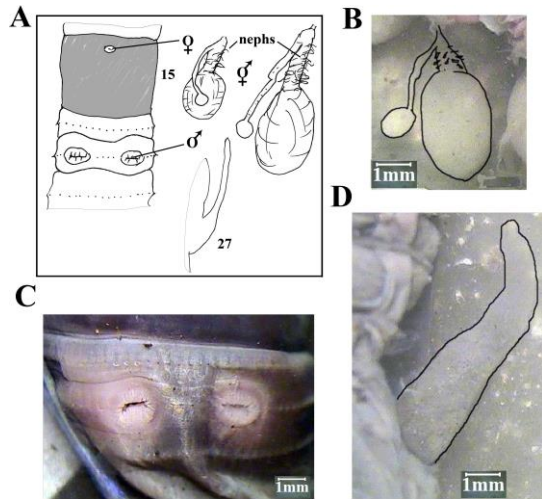


Figure 7. *Pheretima philippina lipa* ssp. nov. Holotype (#S24, DNA P12) with male pores retracted. A = Male field sketch with 9hs spermatheca (plus enlargement) and intestinal caeca; B–D = photos of same with organs outlined.

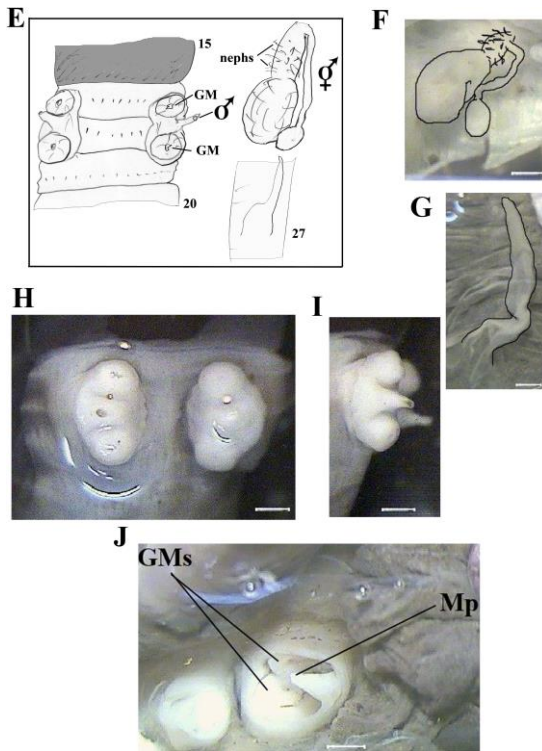


Figure 7. *Pheretima philippina lipa* ssp. nov. Paratype 2 (#S26) with everted male organs: E = Sketch of male field, spermatheca and caecum; F–I photos of same with organs outlined; J = Specimen #S13 (DNA K1b) copulatory pouch sectioned with enclosed penis to male pore (Mp) and GMs either side. DNA K1b matched Holotype's (P12) and other sample 100% – see Fig. 1.

Occidental but see *P. philippina victorias* ssp. nov. below) and *P. callosa* Gates, 1937: 313 from Benguet both of which were thought closely similar. In fact Gates (1937: 315, 329) differentiated his new species *callosa* only by its larger size (330 by 16 mm vs. ca. 120–240 by 8 mm), the larger setal numbers (70–114 vs. 36–70), the rudimentary condition of septum 8/9 (which however was variable), a vertically cleft penis tip, and the binding together of loops of the spermathecal diverticula (in *P. callosa*). The diverticulum in *P. philippina* is typically more straight (and some of the other characters apply more to *P. p. victorias*).

On balance the current specimens comply with *P. philippina* rather than *P. callosa*; slight differences are that the last hearts were in 12 (13 in nominal taxon and S13) and that the intestine commenced in 16 in current specimens (rather than 15 in Gates's specimens – see *P. p. victorias*). Some characters merge with those of *P. callosa* but the spermathecal stalks are straight and the setae apparently fewer; moreover, *P. philippina* has priority should these two taxa eventually merge.

The present sub-species has setae fewer in the anterior and numbering about 40–50 after segment 9 (agreeing with *P. decipiens*); spermathecae in 7–9 with straight diverticula, and septa 8/9/10 aborted, i.e., different to *P. callosa*. The DNA COI barcode, that had no close match on Genbank, is definitive for the new holotype.

Pheretima philippina victorias ssp. nov.

(Figure 1)

?*Pheretima philippina*: Gates 1937: 327. Supposed new material from US Nat. Mus. Cat. No. 20152 one mature specimen “V A18 Adodolay [sic]. Md X. Balabag Silay. Occ. Negros. 12/11/29. No. 109780” and Cat. No. 20153 two matures from “Negros Is. P.I. Bashford Dean. No. 38683.” Note that “Adudulay” is the Ilonggo name for the large black native worms (Delia deGuzman at Hacienda Remedios, pers. comm. Jan. 2014; cf. *Polypheretima elongata* name).

Material examined. Holotype, UPV specimen code #P1 large, dark, subadult providing DNA

tissue sample (Pe1) from Peñalosa home farm/shop Victorias City (10°54'N 123°05'E), Negros Occidental, PI; coll. 28th Jan., 2014 by RJB; Paratype-1 #P3 large, dark mature DNA sample (Pe3) collected same day from Hacienda Remedios organic farm on road beside woodland with many worm castings; Paratype-2 #P5 29th Jan., 2014 HR farm in rice paddy embankment (DNA Pe5 gave no results two months later); other specimens from canefields, paddy and vegetable plots (not kept).

Other material? Apart from Gates' specimens noted above, US Cat. No. 27587 one *Pheretima* specimen from "Hda. Bacayan, Victorias, Occ. Negros. Philippine I. Va2 12/8, 1927 W.D. Pierce GC [Good Condition] Id. G.E. Gates, 1957 Acc. No. 106537."

Diagnosis. Complying tolerably with nominal species morphologically, Gates' specimens were perhaps a bit shorter (122–197 mm) with fewer setae numbering 36 on 8 then to 53–64 (Gates). First dorsal pore was in 12/13 but Gates found a pore-like marking in 11/12 too. Other possible differences described by Gates are presence of thin septum 8/9 and intestinal origin in 15. In one of Gates specimens the copulatory chamber was partially everted exposing posterior GM protuberance. Septum 8/9 was present but 9/10 was lacking. The slender diverticulum typically extends to or beyond ampulla tip (unlike in *P. p. lipa*) and has a seminal chamber of variable shape (Gates).

Etymology. After type location near Victorias City, Negros.

Distribution. Northern Negros Occidental, PI.

Remarks. The DNA barcode data define this taxon separate from the other new sub-sp. (>8%, Fig. 1). Differences from *P. callosa* Gates, 1937 have already been explained.

Amyntas bangoianus (Michaelsen, 1934)

(Figure 8)

Pheretima (Ph.) *bangoiana* Michaelsen, 1934: 505, fig. 6–8. [From Cam Rahn Bay (Port of Ba Ngoi), Vietnam. Type in Paris (576)].

Amyntas bangoianus: Sims and Easton 1972: 236 (*sieboldi*-group); Blakemore 2008b.

Remarks. Michaelsen (1934: 508) states that male pores are simple and that "*Kopulations-taschen*" are absent, thus belonging in *Amyntas* rather than *Metaphire*. In addition, its GMs are clearly quite separate from those typical of *M. bahli* (Gates, 1945) and it is thus removed from supposed synonymy even though it had priority!

Taxonomic note. Sims and Eastons' group taxon, previously *Amyntas sieboldi* (Horst, 1883) that was transferred to *Metaphire* by Blakemore (2003: 34, 2011: 10), is hereby replaced by next prior group representative: *Amyntas carinensis* (Rosa, 1890) as a new *carinensis*-group comprising about 50 taxa, including *A. bangoiana*, listed by Sims and Easton (1972: 236) and Easton (1979: 119).

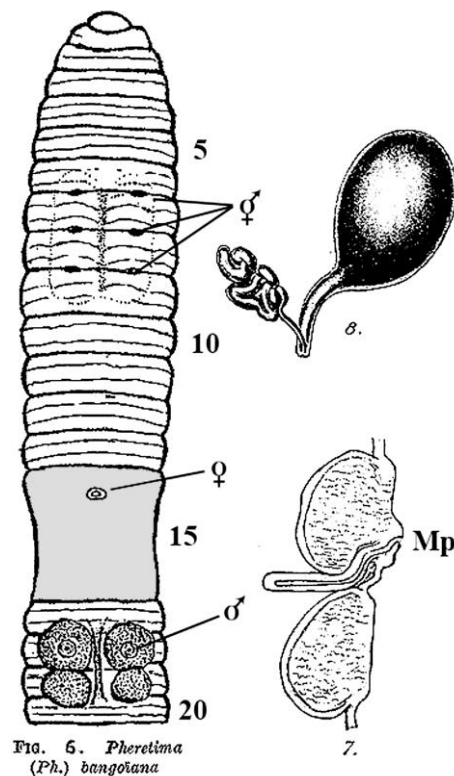


Figure 8. *Amyntas bangoianus* (Michaelsen, 1934: fig. 6–8) (Mp - superficial male pore).

***Metaphire bahli* (Gates, 1945)**

(Figures 1, 9A–D, 10)

Pheretima bahli Gates, 1945: 85. [Type locality Colombo, Sri Lanka. Types, supplied by Kirtisinghe (as *P. peguana*), originally in Prof. Bahl's collection, now lost]; Gates, 1972: 209; Thai, 2000 (part. with supposed syns. *saigonensis*, *bangoiana*).

?*Pheretima* sp. Gates 1972: 210. [Believed from Thailand; male field more depressed than usual in *M. bahli* (cf. *M. peguana*, *M. pacseana*, *M. saigonensis*)].

Metaphire bahli: Sims and Easton 1972: 239 (*peguana*-group); Easton 1982: 730, fig. 4f; Blakemore 1994: 364, 1999: 187, 2002, 2008b, 2009: 265, 2012a.

Material examined. UPV sample #S15 clitellate mature, 135 mm long, dissected and providing DNA sample (K2) from under stone beside farm office Kahariam farm, Lipa City, Batangas, coll. RJB 14th Aug. 2013; #S16 mature 95+ mm long (DNA P1), from same location but in vermicompost beds coll. RJB & RO 14th Nov. 2013; also same day #S18 one of three specimens, 105 mm long from rice paddy near gym (DNA P5); #S20 mature from rice paddy beside gate (DNA P7); plus #P2 longest of four matures providing DNA (Pe2) Penalosa farm, Victorias coll. RJB 28th Jan. 2014; and #S31 two matures (both length = 120 mm), from Hacienda Remedios farm, Negros in cane/banana grove coll. RJB 30th Jan. 2014. Other specimens inspected from Darwin Museum, NT are presented in Results section above.

Diagnosis. Red-brown colour. 110–150 x ca. 4–6 mm. *Metaphire* with paired spermathecal pores 0.25 (Easton, 1982) or <0.5C (Gates, 1972) apart in 6/7/8/9. Diverticula coiled with terminal bulb. Paired GMs in line with male pores in 17/18 & 18/19 always invaginate (cf. *M. peguana*). Intestinal caeca simple.

Distribution. Sri Lanka, the Philippines [previously from Manila and Clark Field (= Angeles City; Gates and pers. obs.), Sual (Pangasinan) and Sibuyan Island (US NMNH Museum specimen), currently from Batangas and Negros as new records], Laos, Vietnam (Thai & Samphon 1989), Cambodia (Thai & Do 1989 and pers. obs. at Angkor Wat Temple, 11th Nov., 2003), Thailand

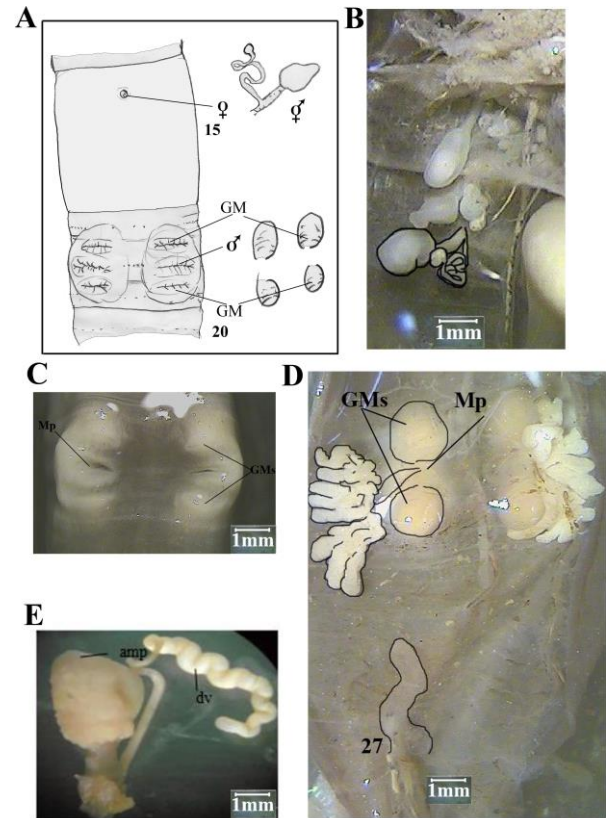


Figure 9. *Metaphire bahli* (Gates, 1945). A = Male field and spermatheca (Darwin specimens); B–D = photos of same from Kahariam #S15 with organs outlined; cf. E = *Metaphire pacseana* (Thai & Samphon, 1988) from Nguyen (2014: fig. 1B).

(Gates 1972: 210, Blakemore 2008a and information in Introduction above), and from northern Australia. Its records in Australia are from around Darwin, NT (Easton 1982): from Snake Bay, Melville Island, Elizabeth River 8 Km S of Darwin and beside Manton River 60 Km S of Darwin; in current studies it was found exclusively in the central Bicentennial park of Darwin through to the Botanic Gardens there with many specimens in drainage ditches or dried on pavements. Gates (1972) thought that the original home may be centered in what is now Thailand/Laos and other records were by introduction. Interestingly, Gates (1972: 210) noted that *M. peguana* and *M. bahli* had not been recorded from the same locality, although Thai & Samphon (1989: 75) and Nguyen (2013: tab. 3.1) recorded them both in Mekong Delta sites in Vietnam (Blakemore *et al.* 2007b: 29).



Figure 10. Indo-Australasian distribution of tropical cosmopolitan *Metaphire* spp. (Asia map courtesy of CIA: <http://www.loc.gov/item/2004627975/#about-this-item>).

Ecology. Current studies found *M. bahli* with organic sugarcane, rice and bananas in PI and in Darwin Botanic Gardens in vicinity of introduced plants including teak (*Tectona grandis* L.) itself native to Thailand/Laos and introduced to Sri Lanka by the Dutch in 1680. If associated with teak plantations it may be expected in Africa and the Caribbean too, but this is just one of many possible means of transportation of what may now be considered such a major cosmopolitan species. Habitats are variable: e.g. parks, fields, woodlands, paddy and in vermicompost wormbeds (Kahariam farm, Batangas). Associated with presence of this worm is rich, well drilled topsoil with copious surface casts in Darwin Gardens where it is predated by Bush Turkey, *Megapodius reinwardt* Dumont, 1823 (pers. obs.), i.e., at least partly a litter dweller, partly a topsoil species. Refuerzo and Reyes (1959) reported it in Philippines as an

intermediate host of nematode *Metastrongylus apri* (Gmelin, 1790) [syn. *Metastrongylus elongatus* (Dujardin, 1845)] lungworms parasitic in domestic pigs or wild boars, occasionally infecting ruminants and, rarely, humans.

Behaviour. Usual ‘snaking’ escape response. Field identification by slight pressure around male pores causes eversion of these plus GMs to give a 6-pointed star formation.

Remarks. Full description is provided in Blakemore (2012a). A Vietnamese paper by Thai (2000) repeated in PhD thesis by T.T. Nguyen (2013: 46) suggested *Pheretima bahli* synonyms of *Metaphire saigonensis* (Omodeo, 1956) and *Amyntas bangoiana* (Michaelsen, 1934) but if it were so, then the latter species would have taken priority from Gates’ *bahli*, as briefly summarized

above. The current study counter-indicates their mutual inclusion as GMs differ at least; moreover, it is now well defined genetically.

***Metaphire pacseana* (Thai & Samphon, 1988)**

(Figure 9E)

Pheretima pacseana Thai & Samphon, 1988: 8. [From Pacse, Laos and ?Vietnam. Types?].
Metaphire pacsana : Blakemore, 2008b: 74.

Remarks. Thai and Samphon (1989: 64, 75) argued that their *pacseana* from Laos explained the relationship between *M. bahli* and *M. peguana*: It has similar markings 17/18 & 18/19 but is larger, up to 270 mm long, with diverticulum twice the length of the ampulla plus duct (no nephridia), and a deeply incised and multiple intestinal caeca. Tentative placement in *Metaphire* by Blakemore (2008) is supported by a photograph in Nguyen (2014: fig. 1B) lacking nephridia on the spermathecal duct (although he yet lists it as “*Ph. pacseana* Thai, 1987”) – see Fig. 9E.

***Polypheretima elongata* (Perrier, 1872) species-complex**

(Figure 1)

Polypheretima elongata complex: Sims & Easton 1972: 252, Easton 1976, 1979.

Comprising: *acystis*, *annectens*, *barami*, *baritoensis*, *biserialis*, *bonensis*, *elongta*, *everetti*, *kinabaluensis*, *klabatensis*, *koroensis*, *mahakkami*, *monocystis*, *phacellotheca*, *sarawacensis*, *seriatus*, *stelleri* & *tinjarana*.

Material examined. From current studies, UPV #S23 three worms in clay near wind-pump at Kahariam farm coll. 14.XI.2013 by RJB & RO (DNA P10-11 from a mature and an immature specimen); mature specimens #R2 from clay at wind-pump and #R3 in sand by stream both collected 21st Jan. 2014 RJB & RO (DNA taken but not sent for testing by UPV); #P4 three specimens, two matures up to 500 mm long from rice and one medium specimen from cane at Hacienda Remedios coll. 28th Jan., 2014 RJB (lat-

ter specimen provided DNA sample Pe4); #S30 five matures from Tagbac farm, Orton in rice paddy coll. 12th Feb., 2014 by UPV staffers & RJB (DNA sample T1 not sent to lab by UPV).

Other material. Gates (1937: 318) mentions specimens from Batoran, Luzon and Negros Island; plus US Nat. Mus. Cat. No. 28711 has one specimen of *Pheretima elongata* (Perrier) labelled “*Lago, Bacayen, Victorias, Occ. Negros, cane-field soil. VAI7 July 8, 1927 W.D. Pierce GC [Good Condition] Id. G.E. Gates 1957 Acc. No. 109780*”. Note “*Lagu*” is the Ilonggo name for long, pale worms (cf. *Ph. p. victorias* name). Easton (1976: 51) has *elongata* specimens from Bataan, Luzon, Mindoro and Manila including “BM(NH) 1904:10.5.1-2 (*biserialis*: Beddard, 1890 ; syntypes of *acystis*)”.

Remarks. Full ecological and taxonomic descriptions of this cosmopolitan species-complex are provided by Easton (1976, 1979) and Blakemore (1994, 2002, 2012a) wherein its misidentification in India for vermicomposting is noted. Although only the nominal species is now reported from the Philippines, BLAST analysis of the DNA data presented here shows >11% difference thus review/restoration of its components is warranted. Consideration should also be give to supposed natives such as *Polypheretima monticola* (Beddard, 1912: 195) from Mt Pulong, Luzon that was itself poorly characterized and is without known types. It was described as 130 mm long with spermathecae paired in 5/6/7/8/9 and GMs paired in 9, 17 & 19–20 in one specimen but not so developed in the other. In this regard this second specimen is the same as *Po. bannaworensis* Hong & James, 2008 which may thus be in synonymy; one other of their Filipino species, *Po. fruticosa*, is *incertae sedis* as the segments are again miscounted in Hong and James (2008: fig. 2A).

Description of two new native *Pleionogaster* species from Philippines

The opportunity is here taken to describe two taxa of the author's concurrent PI studies.

MEGASCOLECIDAE Rosa, 1891

Genus *Pleionogaster* Michaelsen, 1892

Type: *Pl. jagori* Michaelsen, 1892 (non *horsti* Beddard, 1886, see Easton, 1979: 114).

***Pleionogaster adya* sp. nov.**

(Figures 11A–D)

Material examined. UPV#S3: Holotype, quiescent mature (DNA sample W2) found coiled in alluvial soil of banana grove (13:52:14.31323N 121:8:42.36106E) at Kahariam organic farm, Brgy. Adya, Lipa City, Batangas, Luzon; coll. RJB 28th Mar., 2013. [Specimens?: #R5 two matures from sand beside adjacent stream (possibly a different species), coll. RJB & RO 21st Jan., 2014 (DNA R5)].

Description. Unpigmented. Size 145 by 5 mm. Segments *ca.* 100+. Prostomium prolobous. First dorsal pore 11/12. Setae numerous >100 per segment. Nephropores, eight per side (as dark gaps in setal arcs). Spermathecal pores in 7/8/9 *ca.* 0.25C apart. Female pores on 14. Male pores superficial *ca.* 0.3C apart with dozen or more setae between. GMs weak, crescent-shaped pads paired in 17/18 & 18/19 just median to male pore line.

Septa strong in anterior and all present. Oesophageal gizzard in 8. Spermathecae in 8 & 9 as elongate ampulla undifferentiated from duct with stumpy clavate diverticulum $\frac{1}{3}$ as long ectally. Holandric. Testis in 10 & 11; seminal vesicles in 11 & 12. Last hearts in 13. Ovaries in 13. Prostates racemose on short duct in 18. Cal-ciferous glands absent; intestine in 19; caeca absent. Intestinal gizzards appearing in 26–32 (four in series) highly muscularized and each preceded by equisized, flaccid crop. Typhlosole not found. Nephridia meroic in anterior with eight pairs per segment, just one pair visible >18/19.

Etymology. After type locality and only known location, Barangay Adya.

Remarks. Easton (1979: 115) combined *jagori* and *samariensis* Michaelsen, 1892, *ternatae* Michaelsen, 1896 plus *sivickisi* Stephenson, 1933 under *Pl. horsti* Beddard, 1886 whereas James (2006) – while questioning such synonymy but offering no resolution – proposed more than a dozen new species that are themselves mostly similar (many synonymous?). Male pores in current taxon (0.3C) are wider than Easton's *horsti* (*ca.* 0.25) and out of range (0.11–0.18C) of all of James' six species with four gizzards.

Crescentic marking are similar to those of generotype *Pl. horsti*, but the other GMs are lacking (possibly not fully developed) and the four intestinal gizzards appear within 26–32 rather than just 26–28,29. Compared to James' (2006: tab. 1), closest match is perhaps with *Pl. bicolensis* from Bicol, Luzon that, however, is darker with dorsal pores from 12/13, gizzards in 27–30 (*i.e.*, not so extensive), and a dozen nephridia per segment.

DNA data unfortunately unobtainable due to prolonged and avoidable delay in UPV sending tissue samples to the lab.

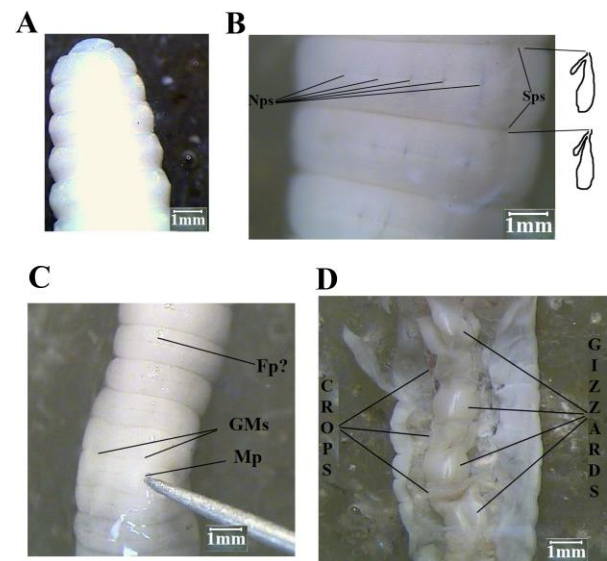


Figure 11. *Pleionogaster adya* sp. nov. Holotype. A = Prostomium; B = Spermathecal field X3 with sketch of spermathecae; C = Male field; D = intestinal gizzards in 26–32.

***Pleionogaster miagao* sp. nov.**

(Figures 1, 12A–H)

Material examined. UPV#S7: Holotype, mature posterior amputee (dissected and providing genseq-1 DNA sample M1) from clay soil Brgy. Cagbang, Miagao (ca. 10°39'N 122°14'E), Iloilo, Panay Island. Coll. Jover Nuevaespana, Jess & King from Sulu Garden (Poseidon Sciences) 6th Feb., 2014.

Description. Unpigmented, clitellum yellowy in 14–16 ventrally and 14½–17 dorsally. Length 150 (+25 bulbous tail) = 175 mm by 6 mm. Segments 153 (+ 25) = 178. Prostomium prolobous (with pharynx everted). First dorsal pore 11/12. Setae numerous >100 per segment. Nephropores equatorial (fourteen to eighteen per segment in anterior). Spermathecal pores with puckered lips in 7/8/9 ca. 0.2C apart. Female pores below crease on 14. Male pores on round porophores as large puckered slits with ca. ten setae between the mounds. GMs represented by broad V-shaped papillae on mid-ventral pad in 16/17 just above setae arc, ellipsoid papillae paired postsetally in 17, broad insunk patches paired below male pores on 18, corresponding weaker pair of presetal papillae in 19 & 20 too, then weaker yet in 21–23 – these latter tapering as unapapillated pads.

Peptonephridial masses in 4 & 5. Septa 5/6/7/8 thickened, thereafter thin. Oesophageal gizzard weak in 8. Spermathecae in 8 & 9 as elongate ampulla on short muscular duct with stumpy clavate diverticulum ¼ as long ectally. Holandric. Testis in sacs in 10 & 11; seminal vesicles 11 & 12 (at least) last pair in 12 with digitiform diverticulum dorsally. Commissurals in 4–9, hearts 10–13. Ovaries fan-shaped sheets in 13; no ovisacs in 14. Prostates crescentic on short duct in 18. Calciferous glands absent; intestine in 19; intestinal caeca absent. Intestinal gizzards in 27–30 (four of) greatly distending segment lengthways with intraseptal crop preceding each. Typhlosole lamellate from ca. 60. Gut contains very fine silty clay without organic material suggesting geophagy. Nephridia meroic, ca. eight pairs per segment in anterior.

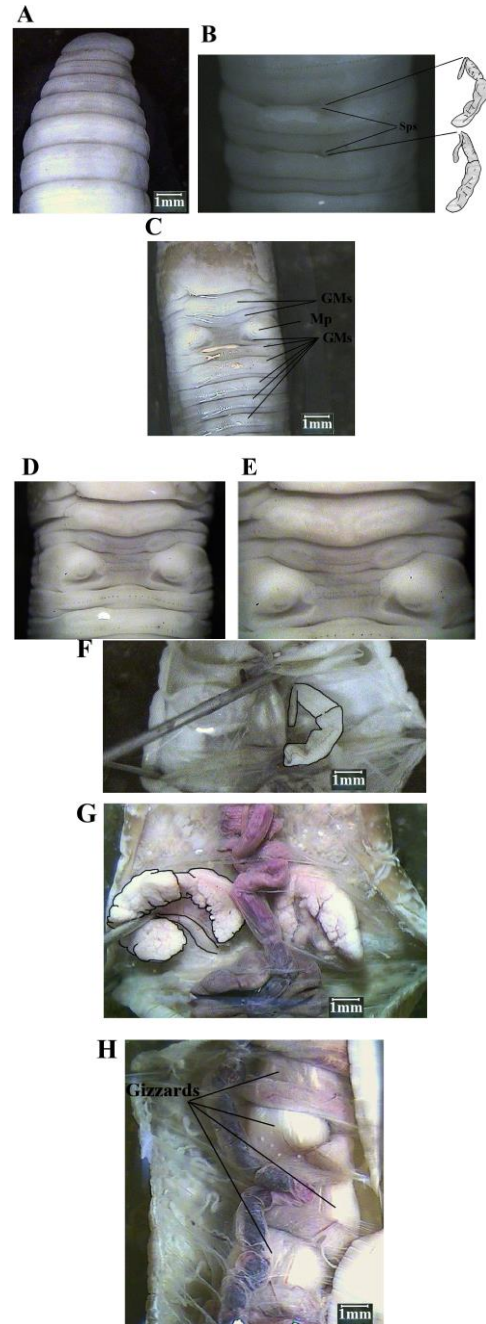


Figure 12. *Pleionogaster miagao* sp. nov. Holotype. A = Prostomium; B = Spermathecal field X2 with sketch of spermathecae; C = Male field X1; D–E Ditto X2–3; F = Spermathecae 8rhs next to oesophageal gizzard; G = Prostates, that on 18lhs outlined and overlain by dorsal blood vessel; H = Intestinal gizzards in 27–30 and lhs meganephridia.

Etymology. After type locality and only known location, Miagao township, Panay.

Remarks. Differences from *Pl. horsti* (Beddard, 1886) are that this often has mid-ventral GMs and the intestinal gizzards are confined in 26-28,29 according to Easton (1979: 115, fig. 46). Closest match with James (2006: tab. 1) is perhaps with *Pl. tiwiensis* from Tiwi, Luzon that has four intestinal gizzards variable in “xxvii-xxx (4), xxv-xxviii (1)”, i.e., in either 27–30 or 25–28; however, it is smaller (94–103 mm) and its spermathecae are 0.08C apart and male pores 0.12C apart with “5–6 setae between male pores” (cf. only four shown in his fig. 1A), fewer nephridia (6–10/segment), no diverticula to seminal vesicles in 12, typhlosole from “xlvii” and diverticulum about half the length of the spermatheca. Insufficient time/funds were available to further describe another *Pleionogaster* sp. n. (l = 25–27 mm #S32) from next to Sulu Gardens, Miagao.

mtDNA COI barcode (KT626595) here provides for the first time a definitive identification of a new *Pleionogaster* species.

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